ACN M2 scientific project proposal.

Title: Design and performance evaluation of a multi-LFU caching policy for wireless networks.

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Context: ACN M2 scientific project proposal.

Problem Statement: The project deals with the problem of caching in wireless networks.

Future wireless nodes can be equipped with memory, where some content (e.g. Video, Audio files, etc.) can temporarily be stored and downloaded directly to the users. This solution will help reduce the internet backbone traffic load. The decision to make a content available on a wireless node - or not, depends on the content popularity among demanding users, which may vary over time. A good caching choice can increase the probability that a user finds its demand on the wireless node (i.e. hit probability), and can help de-congest the backbone network.

There are many particular attributes of wireless networks that can influence the design. One of these is the multi-coverage effect: A user can be covered by more than one node at some position, so that she/he can see the ensemble of files cached in all covering nodes.

The aim of the project is to propose strategies of content update, that exploit multi-coverage.

More specifically, users are considered to arrive at some point in space according to a point process and ask for content from the covering stations. An existing update policy for a single cache is the LFU. This policy updates the considered memory by adding the new object demanded, in case the latter is not already in the cache, and by removing the Least-Frequently-Used one. The LFU is known to be optimal for a single cache under specific types of traffic. It results in a cache inventory that includes objects with the highest popularity within a given time window.

The student should propose a variation of the LFU policy that takes into account the interactions between caches of overlapping coverage regions, the “multi-LFU”. An appropriate choice of the window size should also be proposed for different types of arrival traffics (Independent Reference Model, temporal locality model, etc.), so that popularity can be appropriately estimated.

REFERENCES.

[1] Anastasios Giovanidis, Apostolos Avranas:
Spatial Multi-LRU Caching for Wireless Networks with Coverage Overlaps. SIGMETRICS 2016: 403-405
and also ArXiv longer version: 1602.07623

[2] Valentina Martina, Michele Garetto, Emilio Leonardi .
A unified approach to the performance analysis of caching systems. INFOCOM 2014: 2040-2048

[3] Stefano Traverso, Mohamed Ahmed, Michele Garetto, Paolo Giaccone, Emilio Leonardi, Saverio Niccolini . “Unravelling the Impact of Temporal and Geographical Locality in Content Caching Systems. IEEE Trans. Multimedia 17(10): 1839-1854 (2015)

METHODS & TOOLS.

The work will include a literature survey, development of a simulation environment in the desired programming language of the student, analysis and preparation of a scientific report.

The work will use elements of probabilistic models, point processes and dynamic systems, so courses taken on this area will be very helpful. Some basic knowledge of wireless networks is needed. Programming knowledge is a required skill to be used for simulation and evaluation purposes.

PROJECT ENVIRONMENT

The project will be hosted in a first phase by Telecom ParisTech (23 avenue d'Italie) and in a second phase by another host institution in the Paris area (to be soon determined). The group Networks-Mobility-Services of Telecom ParisTech specializes in research in networks and its performance evaluation. It is a dynamic environment with several researchers and PhD students and allows for interactions and advance of scientific knowledge.